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(54) OPTICAL PICKUP APPARATUS AND OPTICAL INFORMATION-RECORDING/REPRODUCING APPARATUS

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an optical pickup apparatus for which the parallelism of beams for recording and reproduction will not change.
SOLUTION: An optical pickup apparatus 1 has a fixed optical system 11 and a moving optical system 12. The fixed optical system 11 includes a laser 101 for recording and reproduction, a collimator 102 for the laser, a laser 103 for servo, a collimator 104 for the laser, an actuator 105 for moving the collimator 104, and an optical path-combining/splitting prism 106. The moving optical system 12 includes an objective lens 107 and an actuator 108 for moving the lens. To moves a condensing point for a laser light for recording and reproduction in a layer direction inside a recording layer 22 of an optical disk 2, the collimator 104 is first moved for making a laser light substantially parallel for servo, and the objective lens 107 is moved for correcting the displacement of the focal point of the laser light for servo, which is

brought about by moving the collimator.

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CLAIMS

[Claim(s)]
[Claim 1] It is optical pickup equipment for performing informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the reflecting layer top of an optical recording medium, and in a recording layer,

respectively, While making the first beam and second beam both which come from a different direction from the objective lens driving means which directs an objective lens movable in accordance with an optical axis face to an objective lens Optical pickup equipment equipped with a beam composition separation means to make the reflected light from the optical recording medium of each beam which passes along an objective lens go in the direction to which it came, respectively.
[Claim 2] Optical pickup equipment according to claim 1 further equipped with the prism for operating orthopedically so that quantity of light distribution of the second beam cross section may be brought close circularly arranged between the second lens means and a beam composition separation means.
[Claim 3] It is the optical information record regenerative apparatus which performs informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the reflecting layer top of an optical recording medium, and in a recording layer, respectively, While making the first beam and second beam both which come from a different direction from the objective lens driving means which supports an objective lens movable in accordance with an optical axis face to an objective lens A beam composition separation means to make the reflected light from the optical recording medium of each beam which passes along an objective lens go in the direction to which it came, respectively, The optical information record regenerative apparatus equipped with the control means which acts as the feedforward of the driving signal of the first lens driving means to an objective lens driving means including an addition means to add the driving signal of the first lens driving means to the driving signal of an objective lens driving means.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical pickup equipment for performing informational record playback to an optical recording medium. Especially, it

is related with the optical pickup equipment for performing informational record playback using two or more beams to the optical recording medium in which three-dimensions-record is possible. Furthermore, it is related with the optical information record regenerative apparatus using such optical pickup equipment.

[0002]

[Description of the Prior Art] The technique of performing informational record playback independently of the different depth to the recording layer of an optical recording medium is already known. In this specification, the vocabulary "record playback" means performing informational record, playback, or its both.

[0003] It has the comparatively thick recording layer and the reflecting layer for servo control, the optical recording medium, i.e., the optical disk, with which record playback of the information is carried out, and information may be recorded on the depth from which the recording layer differs.

[0004] JP,7-21565,A is indicating an example of the optical pickup equipment used for such three-dimensions-record playback.

[0005] This optical pickup equipment making the reflecting layer of an optical disk condense the beam for servoes, and performing focal control and tracking control based on that reflected light, it makes the beam for record playback condense in the recording layer of an optical disk, changes a recording layer physically locally, and records information, or reproduces information based on that reflected light.

[0006] With this optical pickup equipment, if only the part corresponding to this is moved in accordance with an optical axis to the condensing point of the beam for servoes, it controls and the depth of the condensing point of the beam for record playback in a recording layer puts in another way the condensing point of the beam for record playback by this when the collimator of the light source for record playback is moved by the actuator in accordance with an optical axis, the change of a recording surface is performed.

[0007]

[Problem(s) to be Solved by the Invention] With the optical pickup equipment mentioned above, in order to change the condensing point of the beam for record playback, the collimator of the light source for record playback is moved. For this reason, the parallelism of the beam for record playback is changed with migration of a collimator. Change of the parallelism of the beam for record playback changes the magnitude of the diameter of an incident beam to the effective diameter of an objective lens. This changes the coupling effectiveness (transmission efficiency of light) in an objective lens.

[0008] Therefore, migration of the collimator for changing the depth of a recording layer (a recording surface being changed) changes the optical power which reaches a recording layer in order to change the coupling effectiveness in an objective lens. This bars the stable record playback.

[0009] Especially, it separates into a fixed optical-system part and a migration optical-system part, and fluctuation of the parallelism of the beam for record playback will change the coupling effectiveness in an objective lens also to migration of a migration optical-system part in the so-called configuration of the separation optical system by which only a migration optical-system part is moved at the time of access.
[0010] Therefore, the above-mentioned optical pickup equipment has the fault of being also inapplicable to the separation optical system for being unable to carry out high density record for realizing large capacity to stability, and realizing rapid access.
[0011] Accomplishing this invention in consideration of such the actual condition, the purpose is offering the optical pickup equipment which can perform record playback which did not change the parallelism of the beam for record playback, but was stabilized.
[0012]
[Means for Solving the Problem] This invention is optical pickup equipment for performing informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control in the whole surface. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the reflecting layer top of an optical recording medium, and in a recording layer, respectively, While making the first beam and second beam both which come from a different direction from the objective lens driving means which directs an objective lens movable in accordance with an optical axis face to an objective lens It has a beam composition separation means to make the reflected light from the optical recording medium of each beam which passes along an objective lens go in the direction to which it came, respectively.
[0013] This invention is an optical information record regenerative apparatus which performs informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control in another whole surface. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the

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[0014]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing.

[0015] The optical information record regenerative apparatus by the gestalt of operation of the first of [gestalt of the first operation] this invention is shown in drawing 1 .

[0016] As shown in drawing 1 , the optical pickup equipment 1 of this optical information record regenerative apparatus is equipped with the fixed optical system 11 and the migration optical system 12.

[0017] The fixed optical system 11 has the laser 101 for record playback which injects the laser light for record playback (beam for record playback), the collimator 102 which makes laser light for record playback parallel, the laser 103 for servoes which injects the laser light for servoes (beam for servoes), the collimator 104 which makes laser light for servoes parallel, and the actuator 105 for moving a collimator 104 in accordance with an optical axis.

[0018] The fixed optical system 11 has further the optical-path composition separation prism 106 which compounds the optical path of the laser light for record playback, and the optical path of the laser light for servoes, and is separated. This optical-path composition separation prism 106 makes the reflected light from the disk 2 of each laser light which returns through the migration optical system 12 go in each direction while making both different laser light for record playback and laser light for servoes that come from a direction tend toward the migration optical system 12.

[0019] The fixed optical system 11 has been further arranged between a collimator 102 and the optical-path composition separation prism 106 again. The prism 111 separating, the reflected light, i.e., the playback light, from the disk 2 of the laser light for record playback which returns through the migration optical system 12, The regenerative-signal detection optical system 112 which detects a regenerative signal based on the playback light separated by prism 111, The prism 113 separating, the reflected light, i.e., the servo light, from the disk 2 of the laser light for servoes which has been arranged between a collimator 104 and the optical-path composition

separation prism 106, and which returns through the migration optical system 12, It has the servo signal detection optical system 114 which detects a servo signal based on the servo light separated by prism 111.

[0020] The objective lens 107 for the migration optical system 12 to condense the laser light for record playback and the laser light for servoes which come from the fixed optical system 11, While making the actuator 108 for moving an objective lens 107 in accordance with an optical axis, and the laser light for record playback and the laser light for servoes which comes from the fixed optical system 11 face to an objective lens 107 It has the mirror 109 which makes the playback light which returns from a disk 2 through an objective lens 107, and servo light tend toward the fixed optical system 11.

[0021] The optical element which constitutes this optical pickup equipment 1 is divided into the fixed optical system 11 and the migration optical system 12, and is arranged, there are few components mark and migration optical system 12 is lightweight-ized. For this reason, optical pickup equipment 1 can move the migration optical system 12 at high speed, and rapid access is possible for it.

[0022] Moreover, an optical disk 2 is an optical recording medium in which the so-called three dimensional record is possible, and has the reflecting layer 21 and the recording layer 22. A reflecting layer 21 gives the criteria of servo control, and information may be recorded on a recording layer 22 independently of the different depth. What such an optical recording medium is announced as by ″the Motomitsu Mitsugi memory using the urethane-urea copolymer which has multilayer structure″ (59th Japan Society of Applied Physics academic lecture meeting [besides Ishikawa] 16 a-V -5) etc. is applied.

[0023] It becomes an parallel beam according to a convex lens operation of a collimator 102, the optical-path composition separation prism 106 is penetrated following prism 111, it is reflected by the mirror 109, and the laser light injected from the laser 101 for record playback is condensed with an objective lens 107 by the predetermined depth location in the recording layer 22 of an optical disk 2. A reverse path is followed, it is reflected by prism 111, and the light reflected within the recording layer 22 is led to the regenerative-signal detection optical system 112.

[0024] On the other hand, it becomes an almost parallel beam according to a convex lens operation of a collimator 104, prism 113 is penetrated, and it is reflected by the optical-path composition separation prism 106, and is reflected by the mirror 109, and the laser light injected from the laser 103 for servoes is condensed by the reflecting layer 21 of an optical disk 2 with an objective lens 107. A reverse path is followed, it is reflected by prism 113, and the light reflected by the reflecting layer 21 is led to the optical system 114 for servo signal detection.

[0025] Desirably, the laser 101 for record playback and the laser 103 for servoes emit the light of different wavelength, and the optical-path composition separation prism

106 carries out synthetic separation of the optical path with a wavelength dependency. The dichroic mirror currently indicated by JP,4-291039,A is applied to such optical-path composition separation prism 106.

[0026] Generally, since wavelength extracts and loads a minute spot with a short more nearly laser light, as compared with the laser 103 for servoes, the laser which emits the light of short wavelength is preferably used for the laser 101 for record playback. For example, the laser of 680nm band is used for the laser 101 for record playback, and the laser of 780nm band is used for the laser 103 for servoes.

[0027] Since two laser light is correctly separable by using a dichroic mirror based on wavelength, this optical pickup equipment can perform stable record playback without a mutual interference.

[0028] The servo signal detection optical system 114 detects the focal error signal and tracking error signal according to a focus condition of the laser light for servoes which was injected from the laser 103 for servoes and condensed by the reflecting layer 21. Based on these signals, the servo control circuit 4 controls the location in alignment with the optical axis of an objective lens 108 so that the laser light for servoes connects a focus to a reflecting layer 21.

[0029] Moreover, the regenerative-signal detection optical system 112 detects information recorded on the recording layer 22. The record playback control circuit 3 reproduces data based on the output of the regenerative-signal detection optical system 112, controls the laser 101 for record playback according to the data sent by the host, and performs record to a recording layer 22 while transmitting to the host who does not illustrate the result. Record of data is performed by raising the output power of the laser 101 for record playback, and making a recording layer 22 generate a physical change, for example, change of a refractive index etc.

[0030] The condensing point of the laser for record playback in the interior of a recording layer 22 can change the location which met as follows, the location, i.e., the optical axis, of the direction of a layer. In an initial state, in the laser light for servoes, a focus shall be connected to a reflecting layer 21 and an epilogue and the laser light for record playback shall have connected the focus with the following explanation near the center of a recording layer 22.

[0031] If the laser light for servoes drives an actuator 105 in the condition of focusing to the reflecting layer 21, according to the collimator driving signal shown in drawing 2 (a), as shown in drawing 2 (b), the location of the collimator 104 which carries out abbreviation parallel Guanghua of the injection light of the laser 103 for servoes will change, and the parallelism of the flux of light from a collimator 104 to an objective lens 107 will change.

[0032] Consequently, although the focus condition over a reflector 21 changes, this change is detected by the servo signal detection optical system 114 as a value change of the focal error signal shown in drawing 2 (c). As the servo control circuit 4 is shown

in drawing 2 (d), an actuator 108 is driven according to the objective lens driving signal which negates a focal error, and the location in alignment with the optical axis of an objective lens 107 changes, as shown in drawing 2 (e). Consequently, the condensing point of the laser light for servoes is again moved to a reflecting layer 21, and the value of a focal error signal returns to zero.
[0033] On the other hand, as for the condensing point of the laser light for record playback, only in a part for the objective lens 107 to have moved in accordance with the optical axis since the laser light for record playback was not changing at all, the parallelism moves in accordance with an optical axis in the interior of a recording layer 22.
[0034] That is, the location of the direction of a layer of the condensing point of the laser light for record playback in the interior of a recording layer 22 is changed by changing the location of the collimator 104 of the laser for servo signals.
[0035] Since the parallelism of the laser light for record playback does not change, the beam diameter of the beam light for record playback which carries out incidence does not change to an objective lens 107, either. Therefore, the coupling effectiveness in an objective lens part, i.e., the use effectiveness of light, does not change. Consequently, since the quantity of light which reaches from an objective lens 107 to a recording layer 22 is stabilized, this optical pickup equipment can perform stable record playback.
[0036] In addition, about the laser light for servoes, in order that the parallelism may change, the coupling effectiveness in an objective lens part changes, power fluctuation occurs, but generally, in the servo control circuit 4, since AGC (Auto Gain Control) which standardizes an error signal by the sum signal (the total quantity of light) is operate, the effect of power fluctuation in the error signal detect is absorb, and does not become especially a problem.
[0037] Generally, although the gestalt of [gestalt of the second operation] the first operation made parallel injection light of the laser 101 for record playback with the collimator 102 and has led it to the objective lens 107 as it is, since quantity of light distribution of the injection light of semiconductor laser is an ellipse-like, the way things stand, it will kick and use the quantity of light of the direction of a major axis, and is bad. [of power effectiveness]
[0038] The optical information record regenerative apparatus of the gestalt of the second operation is further equipped with such beam plastic surgery prism 120 arranged between a collimator 102 and prism 111 as the badness [the first] of the power effectiveness of the gestalt of operation is improved and it is shown in drawing 3 . This optical pickup equipment is completely the same as the gestalt of the first operation, except that the beam plastic surgery prism 120 is added.
[0039] Although the beam plastic surgery prism 120 has plane of incidence [**** / un-] and a injection side and does not have a scale factor about a direction

perpendicular to space, about a direction parallel to space, it has a scale factor (having an anamorphic property), and it expands only the one direction (direction parallel to space in drawing 3) of the beam to penetrate, and brings quantity of light distribution of a beam cross section close to a perfect circle. Consequently, a beam cross section serves as an abbreviation perfect circle, it is based on optics including an objective lens 107, and is kicked, and ** becomes there is not less and the use effectiveness of a beam is raised.

[0040] High parallelism is required of the laser light which carries out incidence to the beam plastic surgery prism 120. Because, the beam with low parallelism will have astigmatism, after passing this for the anamorphic property of the beam plastic surgery prism 120. Astigmatism breaks down the spot configuration formed in the interior of a recording layer 22, and bars the stable record playback.

[0041] With the gestalt of this operation, migration of the condensing point of the laser light for record playback is performed by moving the collimator 104 for the laser 103 for servoes which is not used for record playback. Since the collimator 102 for the laser 101 for record playback is not moved for migration of the condensing point of the laser light for record playback, the parallelism of the laser light for record playback which carries out incidence to the beam plastic surgery prism 120 is manageable with a sufficient precision. Therefore, astigmatism does not occur in the laser light for record playback.

[0042] Though high use effectiveness is secured to the laser light for record playback by performing beam plastic surgery according to the gestalt of this operation, since aberration does not occur in the laser light for record playback, stable record playback can be performed also in application to the optical disk drive with a high disk engine speed with which high power is demanded.

[0043] Migration of the condensing point of the laser light for record playback is performed by the gestalt of [gestalt of the third operation] the first operation by moving the collimator 104 which makes laser light for servoes abbreviation parallel first, and moving an objective lens 107 so that a focal gap of the laser light for servoes produced by this migration may be amended. In that case, the focal gap produced by migration of a collimator 104 is detected, an objective lens 107 is moved according to this, and feedback control which returns the condensing point of the laser light for servoes to the location of a reflecting layer 21 is performed.

[0044] Since the interior of a recording layer 22 is moved to the condensing point of the laser light for record playback by feedback control, before the condensing point of the laser light for record playback is arranged in the target position in a recording layer 22, it will require time amount. Specifically, the transit time of the condensing point of the laser light for record playback serves as the sum of the response time of a collimator 104, and the response time of a focal control system in general.

[0045] The optical information record regenerative apparatus by the gestalt of the

third operation aims at an improvement of the access time of the gestalt of such the first operation. The control unit replaced with and applied to the servo control circuit shown in drawing 1 is shown in drawing 4 .

[0046] As shown in drawing 4 , the focal error signal was considered as the input and, as for this control unit 40, at least that for stabilizing the loop formation of focal control is equipped with the phase compensating network 301, the record playback layer setting circuit 302 which sets up the location where the laser light for record playback is condensed, the collimator drive current setting circuit 303, the gain amendment circuit 304, and the adder circuit 305. The output of the collimator drive current setting circuit 303 is inputted into the actuator 105 which drives a collimator 104, and the output of an adder circuit 305 is inputted into the actuator 108 which drives an objective lens 107. The path of feedforward control is constituted by adding a collimator driving signal to an objective lens driving signal through the gain amendment circuit 304.

[0047] The record playback layer setting circuit 302 determines, the direction location of a layer, i.e., the depth location, of the laser light for record playback, and the collimator drive current setting circuit 303 sets up the drive current equivalent to this. An actuator 105 is driven according to the collimator driving signal shown in drawing 5 (a), and as the location of a collimator 104 is shown in drawing 5 (b), it changes.

[0048] After the collimator drive current which can come, simultaneously drives an actuator 105 is inputted also into the gain amendment circuit 304 and amendment of gain is performed, at least an adder circuit 305 is added to the output of the phase compensating network 301. Therefore, the objective lens driving signal shown in drawing 5 (d) is supplied to an actuator 108, and according to this, the location of an objective lens 107 changes to it, as shown in drawing 5 (e).

[0049] The gain amendment circuit 304 outputs the signal which negates exactly the focal gap from the reflecting layer 21 produced by migration of a collimator 104 by migration of an objective lens 107. That is, the gain of the gain amendment circuit 304 is determined by the scale factor of a collimator 104 and an objective lens 107, and the drive sensibility of an actuator 105 and an actuator 108.

[0050] Thus, as compared with control only by feedback control, in order to perform feedforward control to an objective lens 107 to compensate for migration of a collimator 104, location fluctuation of the condensing point of the laser light for servoes is almost lost so that drawing 5 (c) may show. The response time of a focal control system stops that is, influencing the condensing point transit time of the laser light for record playback. Therefore, transit time is decided by the response time of the actuator 105 which drives a collimator 104, and the actuator 108 which drives an objective lens 107. Consequently, the optical information record regenerative apparatus by this operation gestalt can make a change of the depth of the condensing point of the laser light for record playback, i.e., the change of a recording surface, at

high speed.
[0051] Although explained concretely, referring to a drawing about the gestalt [former / some] of operation, this invention is not limited to the gestalt of operation mentioned above, and includes all operations performed in the range which does not deviate from the summary.
[0052] For example, with the gestalt of operation mentioned above, although the beam for record playback described one configuration, it is applicable also to the configuration which performs record playback in parallel by two or more beams for record playback.
[0053] Moreover, although the configuration which separates a beam with a wavelength dependency was described, it is good also as a configuration which separates a beam, for example by polarization.
[0054] This specification includes the following invention.
(1) It is optical pickup equipment for performing informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the reflecting layer top of an optical recording medium, and in a recording layer, respectively, While making the first beam and second beam both which come from a different direction from the objective lens driving means which directs an objective lens movable in accordance with an optical axis face to an objective lens Optical pickup equipment equipped with a beam composition separation means to make the reflected light from the optical recording medium of each beam which passes along an objective lens go in the direction to which it came, respectively.
[0055] (2) Optical pickup equipment given in (1) further equipped with the prism for operating orthopedically so that quantity of light distribution of the second beam cross section may be brought close circularly arranged between the second lens means and a beam composition separation means.
[0056] (3) It is the optical information record regenerative apparatus which performs informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam

parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the reflecting layer top of an optical recording medium, and in a recording layer, respectively, While making the first beam and second beam both which come from a different direction from the objective lens driving means which supports an objective lens movable in accordance with an optical axis face to an objective lens A beam composition separation means to make the reflected light from the optical recording medium of each beam which passes along an objective lens go in the direction to which it came, respectively, The optical information record regenerative apparatus equipped with the control means which acts as the feedforward of the driving signal of the first lens driving means to an objective lens driving means including an addition means to add the driving signal of the first lens driving means to the driving signal of an objective lens driving means.

[0057] (4) It is optical pickup equipment given in (1) which said the first beam and said second beam differ from each other in the wavelength mutually, and is characterized by said beam composition separation means separating a beam with a wavelength dependency.

[0058] (The operation effectiveness) If a wavelength dependency separates a beam, a beam can be separated by low loss, a signal quality will improve, and the record playback by high density will also be attained.

[0059] (5) Optical pickup equipment given in (4) to which the second beam is characterized by being short wavelength rather than the first beam.

[0060] (The operation effectiveness) Since a minute spot is extracted and loaded with more nearly laser light with short wavelength, short wavelength, then high-density record playback are attained in the second beam for record playback.

[0061] (6) Optical pickup equipment given in (1) characterized by being the separation optical system which consists of the migration optical system which contains an objective lens at least, and the fixed optical system which includes the first light source and second light source at least.

[0062] (The operation effectiveness) Since a part for the moving part of pickup can be lightweight-ized by adoption of separation optical system and high-speed migration is attained, rapid access is realizable.

[0063]

[Effect of the Invention] According to this invention, the optical pickup equipment which can perform record playback by which did not change the parallelism of the beam for record playback and it was stabilized is offered. Moreover, since stable record playback can be performed, the optical pickup equipment which applied to separation optical system and realized rapid access can also be offered.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The optical information record regenerative apparatus by the gestalt of operation of the first of this invention is shown.

[Drawing 2] It is a timing diagram for explaining modification of the location of the direction of a layer of the condensing point of the laser for record playback in the optical information record regenerative apparatus of drawing 1 .

[Drawing 3] The optical information record regenerative apparatus by the gestalt of operation of the second of this invention is shown.

[Drawing 4] The control unit replaced with and applied to the servo control circuit of drawing 1 about the gestalt of operation of the third of this invention is shown.

[Drawing 5] It is a timing diagram for explaining modification of the location of the direction of a layer of the condensing point of the laser for record playback by the control unit of drawing 4 .

[Description of Notations]

1 Optical Pickup Equipment

11 Fixed Optical System

12 Migration Optical System

101 Laser for Record Playback

102 Collimator

103 Laser for Servoes

104 Collimator

105 Actuator

106 Optical-Path Composition Separation Prism

107 Objective Lens

108 Actuator

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SOLUTION: An optical pickup apparatus 1 has a fixed optical system 11 and a moving optical system 12. The fixed optical system 11 includes a laser 101 for recording and reproduction, a collimator 102 for the laser, a laser 103 for servo, a collimator 104 for the laser, an actuator 105 for moving the collimator 104, and an optical path-combining/splitting prism 106. The moving optical system 12 includes an objective lens 107 and an actuator 108 for moving the lens. To moves a condensing point for a laser light for recording and reproduction in a layer direction inside a recording layer 22 of an optical disk 2, the collimator 104 is first moved for making a laser light substantially parallel for servo, and the objective lens 107 is moved for correcting the displacement of the focal point of the laser light for servo, which is

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CLAIMS

[Claim(s)]
[Claim 1] It is optical pickup equipment for performing informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the reflecting layer top of an optical recording medium, and in a recording layer,

respectively, While making the first beam and second beam both which come from a different direction from the objective lens driving means which directs an objective lens movable in accordance with an optical axis face to an objective lens Optical pickup equipment equipped with a beam composition separation means to make the reflected light from the optical recording medium of each beam which passes along an objective lens go in the direction to which it came, respectively.

[Claim 2] Optical pickup equipment according to claim 1 further equipped with the prism for operating orthopedically so that quantity of light distribution of the second beam cross section may be brought close circularly arranged between the second lens means and a beam composition separation means.

[Claim 3] It is the optical information record regenerative apparatus which performs informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the reflecting layer top of an optical recording medium, and in a recording layer, respectively, While making the first beam and second beam both which come from a different direction from the objective lens driving means which supports an objective lens movable in accordance with an optical axis face to an objective lens A beam composition separation means to make the reflected light from the optical recording medium of each beam which passes along an objective lens go in the direction to which it came, respectively, The optical information record regenerative apparatus equipped with the control means which acts as the feedforward of the driving signal of the first lens driving means to an objective lens driving means including an addition means to add the driving signal of the first lens driving means to the driving signal of an objective lens driving means.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the optical pickup equipment for performing informational record playback to an optical recording medium. Especially, it

is related with the optical pickup equipment for performing informational record playback using two or more beams to the optical recording medium in which three-dimensions-record is possible. Furthermore, it is related with the optical information record regenerative apparatus using such optical pickup equipment.

[0002]

[Description of the Prior Art] The technique of performing informational record playback independently of the different depth to the recording layer of an optical recording medium is already known. In this specification, the vocabulary "record playback" means performing informational record, playback, or its both.

[0003] It has the comparatively thick recording layer and the reflecting layer for servo control, the optical recording medium, i.e., the optical disk, with which record playback of the information is carried out, and information may be recorded on the depth from which the recording layer differs.

[0004] JP,7-21565,A is indicating an example of the optical pickup equipment used for such three-dimensions-record playback.

[0005] This optical pickup equipment making the reflecting layer of an optical disk condense the beam for servoes, and performing focal control and tracking control based on that reflected light, it makes the beam for record playback condense in the recording layer of an optical disk, changes a recording layer physically locally, and records information, or reproduces information based on that reflected light.

[0006] With this optical pickup equipment, if only the part corresponding to this is moved in accordance with an optical axis to the condensing point of the beam for servoes, it controls and the depth of the condensing point of the beam for record playback in a recording layer puts in another way the condensing point of the beam for record playback by this when the collimator of the light source for record playback is moved by the actuator in accordance with an optical axis, the change of a recording surface is performed.

[0007]

[Problem(s) to be Solved by the Invention] With the optical pickup equipment mentioned above, in order to change the condensing point of the beam for record playback, the collimator of the light source for record playback is moved. For this reason, the parallelism of the beam for record playback is changed with migration of a collimator. Change of the parallelism of the beam for record playback changes the magnitude of the diameter of an incident beam to the effective diameter of an objective lens. This changes the coupling effectiveness (transmission efficiency of light) in an objective lens.

[0008] Therefore, migration of the collimator for changing the depth of a recording layer (a recording surface being changed) changes the optical power which reaches a recording layer in order to change the coupling effectiveness in an objective lens. This bars the stable record playback.

[0009] Especially, it separates into a fixed optical-system part and a migration optical-system part, and fluctuation of the parallelism of the beam for record playback will change the coupling effectiveness in an objective lens also to migration of a migration optical-system part in the so-called configuration of the separation optical system by which only a migration optical-system part is moved at the time of access.
[0010] Therefore, the above-mentioned optical pickup equipment has the fault of being also inapplicable to the separation optical system for being unable to carry out high density record for realizing large capacity to stability, and realizing rapid access.
[0011] Accomplishing this invention in consideration of such the actual condition, the purpose is offering the optical pickup equipment which can perform record playback which did not change the parallelism of the beam for record playback, but was stabilized.
[0012]
[Means for Solving the Problem] This invention is optical pickup equipment for performing informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control in the whole surface. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the reflecting layer top of an optical recording medium, and in a recording layer, respectively, While making the first beam and second beam both which come from a different direction from the objective lens driving means which directs an objective lens movable in accordance with an optical axis face to an objective lens It has a beam composition separation means to make the reflected light from the optical recording medium of each beam which passes along an objective lens go in the direction to which it came, respectively.
[0013] This invention is an optical information record regenerative apparatus which performs informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control in another whole surface. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the

reflecting layer top of an optical recording medium, and in a recording layer, respectively, While making the first beam and second beam both which come from a different direction from the objective lens driving means which supports an objective lens movable in accordance with an optical axis face to an objective lens A beam composition separation means to make the reflected light from the optical recording medium of each beam which passes along an objective lens go in the direction to which it came, respectively, It has the control means which acts as the feedforward of the driving signal of the first lens driving means to an objective lens driving means including an addition means to add the driving signal of the first lens driving means to the driving signal of an objective lens driving means.

[0014]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing.

[0015] The optical information record regenerative apparatus by the gestalt of operation of the first of [gestalt of the first operation] this invention is shown in drawing 1 .

[0016] As shown in drawing 1 , the optical pickup equipment 1 of this optical information record regenerative apparatus is equipped with the fixed optical system 11 and the migration optical system 12.

[0017] The fixed optical system 11 has the laser 101 for record playback which injects the laser light for record playback (beam for record playback), the collimator 102 which makes laser light for record playback parallel, the laser 103 for servoes which injects the laser light for servoes (beam for servoes), the collimator 104 which makes laser light for servoes parallel, and the actuator 105 for moving a collimator 104 in accordance with an optical axis.

[0018] The fixed optical system 11 has further the optical-path composition separation prism 106 which compounds the optical path of the laser light for record playback, and the optical path of the laser light for servoes, and is separated. This optical-path composition separation prism 106 makes the reflected light from the disk 2 of each laser light which returns through the migration optical system 12 go in each direction while making both different laser light for record playback and laser light for servoes that come from a direction tend toward the migration optical system 12.

[0019] The fixed optical system 11 has been further arranged between a collimator 102 and the optical-path composition separation prism 106 again. The prism 111 separating, the reflected light, i.e., the playback light, from the disk 2 of the laser light for record playback which returns through the migration optical system 12, The regenerative-signal detection optical system 112 which detects a regenerative signal based on the playback light separated by prism 111, The prism 113 separating, the reflected light, i.e., the servo light, from the disk 2 of the laser light for servoes which has been arranged between a collimator 104 and the optical-path composition

separation prism 106, and which returns through the migration optical system 12, It has the servo signal detection optical system 114 which detects a servo signal based on the servo light separated by prism 111.

[0020] The objective lens 107 for the migration optical system 12 to condense the laser light for record playback and the laser light for servoes which come from the fixed optical system 11, While making the actuator 108 for moving an objective lens 107 in accordance with an optical axis, and the laser light for record playback and the laser light for servoes which comes from the fixed optical system 11 face to an objective lens 107 It has the mirror 109 which makes the playback light which returns from a disk 2 through an objective lens 107, and servo light tend toward the fixed optical system 11.

[0021] The optical element which constitutes this optical pickup equipment 1 is divided into the fixed optical system 11 and the migration optical system 12, and is arranged, there are few components mark and migration optical system 12 is lightweight-ized. For this reason, optical pickup equipment 1 can move the migration optical system 12 at high speed, and rapid access is possible for it.

[0022] Moreover, an optical disk 2 is an optical recording medium in which the so-called three dimensional record is possible, and has the reflecting layer 21 and the recording layer 22. A reflecting layer 21 gives the criteria of servo control, and information may be recorded on a recording layer 22 independently of the different depth. What such an optical recording medium is announced as by "the Motomitsu Mitsugi memory using the urethane-urea copolymer which has multilayer structure" (59th Japan Society of Applied Physics academic lecture meeting [besides Ishikawa] 16 a-V -5) etc. is applied.

[0023] It becomes an parallel beam according to a convex lens operation of a collimator 102, the optical-path composition separation prism 106 is penetrated following prism 111, it is reflected by the mirror 109, and the laser light injected from the laser 101 for record playback is condensed with an objective lens 107 by the predetermined depth location in the recording layer 22 of an optical disk 2. A reverse path is followed, it is reflected by prism 111, and the light reflected within the recording layer 22 is led to the regenerative-signal detection optical system 112.

[0024] On the other hand, it becomes an almost parallel beam according to a convex lens operation of a collimator 104, prism 113 is penetrated, and it is reflected by the optical-path composition separation prism 106, and is reflected by the mirror 109, and the laser light injected from the laser 103 for servoes is condensed by the reflecting layer 21 of an optical disk 2 with an objective lens 107. A reverse path is followed, it is reflected by prism 113, and the light reflected by the reflecting layer 21 is led to the optical system 114 for servo signal detection.

[0025] Desirably, the laser 101 for record playback and the laser 103 for servoes emit the light of different wavelength, and the optical-path composition separation prism

106 carries out synthetic separation of the optical path with a wavelength dependency. The dichroic mirror currently indicated by JP,4-291039,A is applied to such optical-path composition separation prism 106.

[0026] Generally, since wavelength extracts and loads a minute spot with a short more nearly laser light, as compared with the laser 103 for servoes, the laser which emits the light of short wavelength is preferably used for the laser 101 for record playback. For example, the laser of 680nm band is used for the laser 101 for record playback, and the laser of 780nm band is used for the laser 103 for servoes.

[0027] Since two laser light is correctly separable by using a dichroic mirror based on wavelength, this optical pickup equipment can perform stable record playback without a mutual interference.

[0028] The servo signal detection optical system 114 detects the focal error signal and tracking error signal according to a focus condition of the laser light for servoes which was injected from the laser 103 for servoes and condensed by the reflecting layer 21. Based on these signals, the servo control circuit 4 controls the location in alignment with the optical axis of an objective lens 108 so that the laser light for servoes connects a focus to a reflecting layer 21.

[0029] Moreover, the regenerative-signal detection optical system 112 detects information recorded on the recording layer 22. The record playback control circuit 3 reproduces data based on the output of the regenerative-signal detection optical system 112, controls the laser 101 for record playback according to the data sent by the host, and performs record to a recording layer 22 while transmitting to the host who does not illustrate the result. Record of data is performed by raising the output power of the laser 101 for record playback, and making a recording layer 22 generate a physical change, for example, change of a refractive index etc.

[0030] The condensing point of the laser for record playback in the interior of a recording layer 22 can change the location which met as follows, the location, i.e., the optical axis, of the direction of a layer. In an initial state, in the laser light for servoes, a focus shall be connected to a reflecting layer 21 and an epilogue and the laser light for record playback shall have connected the focus with the following explanation near the center of a recording layer 22.

[0031] If the laser light for servoes drives an actuator 105 in the condition of focusing to the reflecting layer 21, according to the collimator driving signal shown in drawing 2 (a), as shown in drawing 2 (b), the location of the collimator 104 which carries out abbreviation parallel Guanghua of the injection light of the laser 103 for servoes will change, and the parallelism of the flux of light from a collimator 104 to an objective lens 107 will change.

[0032] Consequently, although the focus condition over a reflector 21 changes, this change is detected by the servo signal detection optical system 114 as a value change of the focal error signal shown in drawing 2 (c). As the servo control circuit 4 is shown

in drawing 2 (d), an actuator 108 is driven according to the objective lens driving signal which negates a focal error, and the location in alignment with the optical axis of an objective lens 107 changes, as shown in drawing 2 (e). Consequently, the condensing point of the laser light for servoes is again moved to a reflecting layer 21, and the value of a focal error signal returns to zero.

[0033] On the other hand, as for the condensing point of the laser light for record playback, only in a part for the objective lens 107 to have moved in accordance with the optical axis since the laser light for record playback was not changing at all, the parallelism moves in accordance with an optical axis in the interior of a recording layer 22.

[0034] That is, the location of the direction of a layer of the condensing point of the laser light for record playback in the interior of a recording layer 22 is changed by changing the location of the collimator 104 of the laser for servo signals.

[0035] Since the parallelism of the laser light for record playback does not change, the beam diameter of the beam light for record playback which carries out incidence does not change to an objective lens 107, either. Therefore, the coupling effectiveness in an objective lens part, i.e., the use effectiveness of light, does not change. Consequently, since the quantity of light which reaches from an objective lens 107 to a recording layer 22 is stabilized, this optical pickup equipment can perform stable record playback.

[0036] In addition, about the laser light for servoes, in order that the parallelism may change, the coupling effectiveness in an objective lens part changes, power fluctuation occurs, but generally, in the servo control circuit 4, since AGC (Auto Gain Control) which standardizes an error signal by the sum signal (the total quantity of light) is operate, the effect of power fluctuation in the error signal detect is absorb, and does not become especially a problem.

[0037] Generally, although the gestalt of [gestalt of the second operation] the first operation made parallel injection light of the laser 101 for record playback with the collimator 102 and has led it to the objective lens 107 as it is, since quantity of light distribution of the injection light of semiconductor laser is an ellipse-like, the way things stand, it will kick and use the quantity of light of the direction of a major axis, and is bad. [of power effectiveness]

[0038] The optical information record regenerative apparatus of the gestalt of the second operation is further equipped with such beam plastic surgery prism 120 arranged between a collimator 102 and prism 111 as the badness [the first] of the power effectiveness of the gestalt of operation is improved and it is shown in drawing 3 . This optical pickup equipment is completely the same as the gestalt of the first operation, except that the beam plastic surgery prism 120 is added.

[0039] Although the beam plastic surgery prism 120 has plane of incidence [**** / un-] and a injection side and does not have a scale factor about a direction

perpendicular to space, about a direction parallel to space, it has a scale factor (having an anamorphic property), and it expands only the one direction (direction parallel to space in drawing 3) of the beam to penetrate, and brings quantity of light distribution of a beam cross section close to a perfect circle. Consequently, a beam cross section serves as an abbreviation perfect circle, it is based on optics including an objective lens 107, and is kicked, and ** becomes there is not less and the use effectiveness of a beam is raised.

[0040] High parallelism is required of the laser light which carries out incidence to the beam plastic surgery prism 120. Because, the beam with low parallelism will have astigmatism, after passing this for the anamorphic property of the beam plastic surgery prism 120. Astigmatism breaks down the spot configuration formed in the interior of a recording layer 22, and bars the stable record playback.

[0041] With the gestalt of this operation, migration of the condensing point of the laser light for record playback is performed by moving the collimator 104 for the laser 103 for servoes which is not used for record playback. Since the collimator 102 for the laser 101 for record playback is not moved for migration of the condensing point of the laser light for record playback, the parallelism of the laser light for record playback which carries out incidence to the beam plastic surgery prism 120 is manageable with a sufficient precision. Therefore, astigmatism does not occur in the laser light for record playback.

[0042] Though high use effectiveness is secured to the laser light for record playback by performing beam plastic surgery according to the gestalt of this operation, since aberration does not occur in the laser light for record playback, stable record playback can be performed also in application to the optical disk drive with a high disk engine speed with which high power is demanded.

[0043] Migration of the condensing point of the laser light for record playback is performed by the gestalt of [gestalt of the third operation] the first operation by moving the collimator 104 which makes laser light for servoes abbreviation parallel first, and moving an objective lens 107 so that a focal gap of the laser light for servoes produced by this migration may be amended. In that case, the focal gap produced by migration of a collimator 104 is detected, an objective lens 107 is moved according to this, and feedback control which returns the condensing point of the laser light for servoes to the location of a reflecting layer 21 is performed.

[0044] Since the interior of a recording layer 22 is moved to the condensing point of the laser light for record playback by feedback control, before the condensing point of the laser light for record playback is arranged in the target position in a recording layer 22, it will require time amount. Specifically, the transit time of the condensing point of the laser light for record playback serves as the sum of the response time of a collimator 104, and the response time of a focal control system in general.

[0045] The optical information record regenerative apparatus by the gestalt of the

third operation aims at an improvement of the access time of the gestalt of such the first operation. The control unit replaced with and applied to the servo control circuit shown in drawing 1 is shown in drawing 4 .

[0046] As shown in drawing 4 , the focal error signal was considered as the input and, as for this control unit 40, at least that for stabilizing the loop formation of focal control is equipped with the phase compensating network 301, the record playback layer setting circuit 302 which sets up the location where the laser light for record playback is condensed, the collimator drive current setting circuit 303, the gain amendment circuit 304, and the adder circuit 305. The output of the collimator drive current setting circuit 303 is inputted into the actuator 105 which drives a collimator 104, and the output of an adder circuit 305 is inputted into the actuator 108 which drives an objective lens 107. The path of feedforward control is constituted by adding a collimator driving signal to an objective lens driving signal through the gain amendment circuit 304.

[0047] The record playback layer setting circuit 302 determines, the direction location of a layer, i.e., the depth location, of the laser light for record playback, and the collimator drive current setting circuit 303 sets up the drive current equivalent to this. An actuator 105 is driven according to the collimator driving signal shown in drawing 5 (a), and as the location of a collimator 104 is shown in drawing 5 (b), it changes.

[0048] After the collimator drive current which can come, simultaneously drives an actuator 105 is inputted also into the gain amendment circuit 304 and amendment of gain is performed, at least an adder circuit 305 is added to the output of the phase compensating network 301. Therefore, the objective lens driving signal shown in drawing 5 (d) is supplied to an actuator 108, and according to this, the location of an objective lens 107 changes to it, as shown in drawing 5 (e).

[0049] The gain amendment circuit 304 outputs the signal which negates exactly the focal gap from the reflecting layer 21 produced by migration of a collimator 104 by migration of an objective lens 107. That is, the gain of the gain amendment circuit 304 is determined by the scale factor of a collimator 104 and an objective lens 107, and the drive sensibility of an actuator 105 and an actuator 108.

[0050] Thus, as compared with control only by feedback control, in order to perform feedforward control to an objective lens 107 to compensate for migration of a collimator 104, location fluctuation of the condensing point of the laser light for servoes is almost lost so that drawing 5 (c) may show. The response time of a focal control system stops that is, influencing the condensing point transit time of the laser light for record playback. Therefore, transit time is decided by the response time of the actuator 105 which drives a collimator 104, and the actuator 108 which drives an objective lens 107. Consequently, the optical information record regenerative apparatus by this operation gestalt can make a change of the depth of the condensing point of the laser light for record playback, i.e., the change of a recording surface, at

high speed.

[0051] Although explained concretely, referring to a drawing about the gestalt [former / some] of operation, this invention is not limited to the gestalt of operation mentioned above, and includes all operations performed in the range which does not deviate from the summary.

[0052] For example, with the gestalt of operation mentioned above, although the beam for record playback described one configuration, it is applicable also to the configuration which performs record playback in parallel by two or more beams for record playback.

[0053] Moreover, although the configuration which separates a beam with a wavelength dependency was described, it is good also as a configuration which separates a beam, for example by polarization.

[0054] This specification includes the following invention.

(1) It is optical pickup equipment for performing informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the reflecting layer top of an optical recording medium, and in a recording layer, respectively, While making the first beam and second beam both which come from a different direction from the objective lens driving means which directs an objective lens movable in accordance with an optical axis face to an objective lens Optical pickup equipment equipped with a beam composition separation means to make the reflected light from the optical recording medium of each beam which passes along an objective lens go in the direction to which it came, respectively.

[0055] (2) Optical pickup equipment given in (1) further equipped with the prism for operating orthopedically so that quantity of light distribution of the second beam cross section may be brought close circularly arranged between the second lens means and a beam composition separation means.

[0056] (3) It is the optical information record regenerative apparatus which performs informational record playback to the optical recording medium which has the recording layer on which information may be recorded independently of the different depth from the reflecting layer which gives the criteria of servo control. The first light source which emits the first beam for servo control, and the second light source which emits the second beam for record playback, The first lens means which makes the first beam abbreviation parallel, and the second lens means which makes the second beam

parallel, The first lens driving means which supports the first lens means movable in accordance with the optical axis of the first beam, The objective lens for condensing the first beam and second beam the reflecting layer top of an optical recording medium, and in a recording layer, respectively, While making the first beam and second beam both which come from a different direction from the objective lens driving means which supports an objective lens movable in accordance with an optical axis face to an objective lens A beam composition separation means to make the reflected light from the optical recording medium of each beam which passes along an objective lens go in the direction to which it came, respectively, The optical information record regenerative apparatus equipped with the control means which acts as the feedforward of the driving signal of the first lens driving means to an objective lens driving means including an addition means to add the driving signal of the first lens driving means to the driving signal of an objective lens driving means.

[0057] (4) It is optical pickup equipment given in (1) which said the first beam and said second beam differ from each other in the wavelength mutually, and is characterized by said beam composition separation means separating a beam with a wavelength dependency.

[0058] (The operation effectiveness) If a wavelength dependency separates a beam, a beam can be separated by low loss, a signal quality will improve, and the record playback by high density will also be attained.

[0059] (5) Optical pickup equipment given in (4) to which the second beam is characterized by being short wavelength rather than the first beam.

[0060] (The operation effectiveness) Since a minute spot is extracted and loaded with more nearly laser light with short wavelength, short wavelength, then high-density record playback are attained in the second beam for record playback.

[0061] (6) Optical pickup equipment given in (1) characterized by being the separation optical system which consists of the migration optical system which contains an objective lens at least, and the fixed optical system which includes the first light source and second light source at least.

[0062] (The operation effectiveness) Since a part for the moving part of pickup can be lightweight-ized by adoption of separation optical system and high-speed migration is attained, rapid access is realizable.

[0063]

[Effect of the Invention] According to this invention, the optical pickup equipment which can perform record playback by which did not change the parallelism of the beam for record playback and it was stabilized is offered. Moreover, since stable record playback can be performed, the optical pickup equipment which applied to separation optical system and realized rapid access can also be offered.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The optical information record regenerative apparatus by the gestalt of operation of the first of this invention is shown.

[Drawing 2] It is a timing diagram for explaining modification of the location of the direction of a layer of the condensing point of the laser for record playback in the optical information record regenerative apparatus of drawing 1 .

[Drawing 3] The optical information record regenerative apparatus by the gestalt of operation of the second of this invention is shown.

[Drawing 4] The control unit replaced with and applied to the servo control circuit of drawing 1 about the gestalt of operation of the third of this invention is shown.

[Drawing 5] It is a timing diagram for explaining modification of the location of the direction of a layer of the condensing point of the laser for record playback by the control unit of drawing 4 .

[Description of Notations]

1 Optical Pickup Equipment
11 Fixed Optical System
12 Migration Optical System
101 Laser for Record Playback
102 Collimator
103 Laser for Servoes
104 Collimator
105 Actuator
106 Optical-Path Composition Separation Prism
107 Objective Lens
108 Actuator

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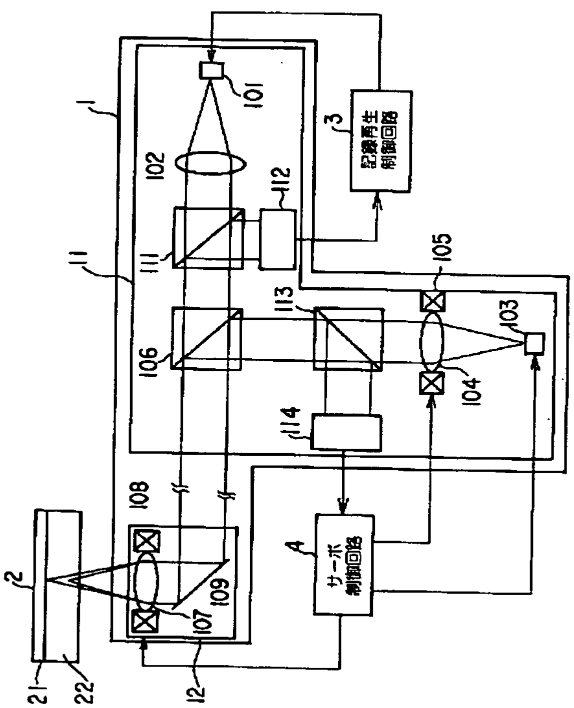
(54)【発明の名称】　光ピックアップ装置及び光学式情報記録再生装置

(57)【要約】

【課題】記録再生用ビームの平行度が変動しない光ピックアップ装置を提供する。

【解決手段】光ピックアップ装置１は固定光学系１１と移動光学系１２を備えている。固定光学系１１は、記録再生用レーザー１０１とそのコリメータ１０２、サーボ用レーザー１０３とそのコリメータ１０４、コリメータ１０４を移動させるアクチュエータ１０５、光路合成分離プリズム１０６を有している。移動光学系１２は、対物レンズ１０７と、これを移動させるアクチュエータ１０８を備えている。光ディスク２の記録層２２の内部における記録再生用レーザー光の集光点の層方向の移動は、最初にサーボ用レーザー光を略平行化するコリメータ１０４を移動させ、この移動により生じたサーボ用レーザー光の焦点ずれを補正するように対物レンズ１０７を移動させることで行なわれる。



【特許請求の範囲】

【請求項１】　サーボ制御の基準を与える反射層と異なる深さに独立に情報が記録され得る記録層とを有する光記録媒体に対して情報の記録再生を行なうための光ピックアップ装置であり、
サーボ制御のための第一のビームを発する第一の光源と、
記録再生のための第二のビームを発する第二の光源と、
第一のビームを略平行化する第一のレンズ手段と、
第二のビームを平行化する第二のレンズ手段と、
第一のレンズ手段を第一のビームの光軸に沿って移動可能に支持する第一のレンズ駆動手段と、
第一のビームと第二のビームをそれぞれ光記録媒体の反射層上と記録層中に集光するための対物レンズと、
対物レンズを光軸に沿って移動可能に指示する対物レンズ駆動手段と、
異なる方向から来る第一のビームと第二のビームを共に対物レンズに向かわせるとともに、対物レンズを通ってくるそれぞれのビームの光記録媒体からの反射光をそれぞれ来た方向に向かわせるビーム合成分離手段とを備えている光ピックアップ装置。

【請求項２】　第二のレンズ手段とビーム合成分離手段との間に配置された、第二のビーム断面の光量分布を円形に近づけるよう整形するためのプリズムを更に備えている、請求項１に記載の光ピックアップ装置。

【請求項３】　サーボ制御の基準を与える反射層と異なる深さに独立に情報が記録され得る記録層とを有する光記録媒体に対して情報の記録再生を行なう光学式情報記録再生装置であり、
サーボ制御のための第一のビームを発する第一の光源と、
記録再生のための第二のビームを発する第二の光源と、
第一のビームを略平行化する第一のレンズ手段と、
第二のビームを平行化する第二のレンズ手段と、
第一のレンズ手段を第一のビームの光軸に沿って移動可能に支持する第一のレンズ駆動手段と、
第一のビームと第二のビームをそれぞれ光記録媒体の反射層上と記録層中に集光するための対物レンズと、
対物レンズを光軸に沿って移動可能に支持する対物レンズ駆動手段と、
異なる方向から来る第一のビームと第二のビームを共に対物レンズに向かわせるとともに、対物レンズを通ってくるそれぞれのビームの光記録媒体からの反射光をそれぞれ来た方向に向かわせるビーム合成分離手段と、
第一のレンズ駆動手段の駆動信号を対物レンズ駆動手段の駆動信号に加算する加算手段を含み、第一のレンズ駆動手段の駆動信号を対物レンズ駆動手段へフィードフォワードする制御手段とを備えている光学式情報記録再生装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、光記録媒体に対して情報の記録再生を行なうための光ピックアップ装置に関する。特に、三次元的な記録が可能な光記録媒体に対して、複数のビームを用いて情報の記録再生を行なうための光ピックアップ装置に関する。さらには、このような光ピックアップ装置を用いた光学式情報記録再生装置に関する。

【０００２】

【従来の技術】光記録媒体の記録層に対して異なる深さに独立に情報の記録再生を行なう技術は既に知られている。本明細書において「記録再生」という用語は、情報の記録または再生またはその両方を行なうことを意味する。

【０００３】情報が記録再生される光記録媒体すなわち光ディスクは、比較的厚い記録層とサーボ制御のための反射層とを有しており、その記録層の異なる深さに情報が記録され得る。

【０００４】特開平７－２１５６５号は、このような三次元的記録再生に用いられる光ピックアップ装置の一例を開示している。

【０００５】この光ピックアップ装置は、サーボ用ビームを光ディスクの反射層に集光させ、その反射光に基づいてフォーカス制御とトラッキング制御を行ないつつ、記録再生用ビームを光ディスクの記録層内に集光させ、記録層を局所的に物理的に変化させて情報の記録を行ない、あるいは、その反射光に基づいて情報の再生を行なう。

【０００６】この光ピックアップ装置では、記録再生用ビームの集光点は、記録再生用光源のコリメータがアクチュエータにより光軸に沿って移動されることによって、これに対応する分だけサーボ用ビームの集光点に対して光軸に沿って移動され、これにより記録層内における記録再生用ビームの集光点の深さの制御、言い換えれば記録面の切り替えが行なわれている。

【０００７】

【発明が解決しようとする課題】上述した光ピックアップ装置では、記録再生用ビームの集光点を変化させるために、記録再生用光源のコリメータを移動させている。このため、記録再生用ビームの平行度はコリメータの移動に伴って変動する。記録再生用ビームの平行度の変化は、対物レンズの有効径に対する入射ビーム径の大きさを変化させる。これは、対物レンズでのカップリング効率(光の伝達効率)を変化させる。

【０００８】従って、記録層の深さを変更する(記録面を切り替える)ためのコリメータの移動は、対物レンズでのカップリング効率を変化させるため、記録層に達する光パワーを変化させる。これは、安定した記録再生を妨げる。

【０００９】特に、固定光学系部分と移動光学系部分に

分離され、移動光学系部分だけがアクセス時に移動される、いわゆる分離光学系の構成においては、記録再生用ビームの平行度の変動は、移動光学系部分の移動に対しても、対物レンズでのカップリング効率を変化させてしまう。

【００１０】従って、前述の光ピックアップ装置は、大容量を実現するための高密度記録を安定に行なうことが出来ず、また高速アクセスを実現するための分離光学系に適用することも出来ないという不具合を有している。

【００１１】本発明は、このような実状を考慮して成されたものであり、その目的は、記録再生用ビームの平行度が変動せず安定した記録再生を行なえる光ピックアップ装置を提供することである。

【００１２】

【課題を解決するための手段】本発明は、一面において、サーボ制御の基準を与える反射層と異なる深さに独立に情報が記録され得る記録層とを有する光記録媒体に対して情報の記録再生を行なうための光ピックアップ装置であり、サーボ制御のための第一のビームを発する第一の光源と、記録再生のための第二のビームを発する第二の光源と、第一のビームを略平行化する第一のレンズ手段と、第二のビームを平行化する第二のレンズ手段と、第一のレンズ手段を第一のビームの光軸に沿って移動可能に支持する第一のレンズ駆動手段と、第一のビームと第二のビームをそれぞれ光記録媒体の反射層上と記録層中に集光するための対物レンズと、対物レンズを光軸に沿って移動可能に指示する対物レンズ駆動手段と、異なる方向から来る第一のビームと第二のビームを共に対物レンズに向かわせるとともに、対物レンズを通ってくるそれぞれのビームの光記録媒体からの反射光をそれぞれ来た方向に向かわせるビーム合成分離手段とを備えている。

【００１３】本発明は、別の一面において、サーボ制御の基準を与える反射層と異なる深さに独立に情報が記録され得る記録層とを有する光記録媒体に対して情報の記録再生を行なう光学式情報記録再生装置であり、サーボ制御のための第一のビームを発する第一の光源と、記録再生のための第二のビームを発する第二の光源と、第一のビームを略平行化する第一のレンズ手段と、第二のビームを平行化する第二のレンズ手段と、第一のレンズ手段を第一のビームの光軸に沿って移動可能に支持する第一のレンズ駆動手段と、第一のビームと第二のビームをそれぞれ光記録媒体の反射層上と記録層中に集光するための対物レンズと、対物レンズを光軸に沿って移動可能に支持する対物レンズ駆動手段と、異なる方向から来る第一のビームと第二のビームを共に対物レンズに向かわせるとともに、対物レンズを通ってくるそれぞれのビームの光記録媒体からの反射光をそれぞれ来た方向に向かわせるビーム合成分離手段と、第一のレンズ駆動手段の駆動信号を対物レンズ駆動手段の駆動信号に加算する加

算手段を含み、第一のレンズ駆動手段の駆動信号を対物レンズ駆動手段へフィードフォワードする制御手段とを備えている。

【００１４】

【発明の実施の形態】以下、図面を参照しながら本発明の実施の形態について説明する。

【００１５】［第一の実施の形態］本発明の第一の実施の形態による光学式情報記録再生装置を図１に示す。

【００１６】図１に示されるように、この光学式情報記録再生装置の光ピックアップ装置１は、固定光学系１１と移動光学系１２とを備えている。

【００１７】固定光学系１１は、記録再生用レーザー光(記録再生用ビーム)を射出する記録再生用レーザー１０１と、記録再生用レーザー光を平行化するコリメータ１０２と、サーボ用レーザー光(サーボ用ビーム)を射出するサーボ用レーザー１０３と、サーボ用レーザー光を平行化するコリメータ１０４と、コリメータ１０４を光軸に沿って移動させるためのアクチュエータ１０５とを有している。

【００１８】固定光学系１１は、さらに、記録再生用レーザー光の光路とサーボ用レーザー光の光路を合成し分離する光路合成分離プリズム１０６を有している。この光路合成分離プリズム１０６は、異なる方向から来る記録再生用レーザー光とサーボ用レーザー光を共に移動光学系１２に向かわせるとともに、移動光学系１２を経て戻って来るそれぞれのレーザー光のディスク２からの反射光をそれぞれの方向に向かわせる。

【００１９】固定光学系１１は、またさらに、コリメータ１０２と光路合成分離プリズム１０６の間に配置された、移動光学系１２を経て戻って来る記録再生用レーザー光のディスク２からの反射光すなわち再生光を分離するプリズム１１１と、プリズム１１１により分離された再生光に基づいて再生信号を検出する再生信号検出光学系１１２と、コリメータ１０４と光路合成分離プリズム１０６の間に配置された、移動光学系１２を経て戻って来るサーボ用レーザー光のディスク２からの反射光すなわちサーボ光を分離するプリズム１１３と、プリズム１１１により分離されたサーボ光に基づいてサーボ信号を検出するサーボ信号検出光学系１１４とを備えている。

【００２０】移動光学系１２は、固定光学系１１から来る記録再生用レーザー光とサーボ用レーザー光を集光するための対物レンズ１０７と、対物レンズ１０７を光軸に沿って移動させるためのアクチュエータ１０８と、固定光学系１１から来る記録再生用レーザー光とサーボ用レーザー光を対物レンズ１０７に向かわせるとともに、ディスク２から対物レンズ１０７を通って戻る再生光とサーボ光を固定光学系１１に向かわせるミラー１０９とを備えている。

【００２１】この光ピックアップ装置１を構成する光学素子は固定光学系１１と移動光学系１２とに分けて配置

されており、移動光学系１２は部品点数が少なく軽量化されている。このため、光ピックアップ装置１は、移動光学系１２を高速で移動させることができ、高速アクセスが可能である。

【００２２】また、光ディスク２は、いわゆる三次元記録が可能な光記録媒体であり、反射層２１と記録層２２を有している。反射層２１はサーボ制御の基準を与え、記録層２２には異なる深さに独立に情報が記録され得る。このような光記録媒体は、例えば「多層構造を有するウレタン－ウレア共重合体を用いた三次元光メモリ」(石川他、第５９回応用物理学会学術講演会16a-V-5)等で発表されているものが適用される。

【００２３】記録再生用レーザー１０１から射出されたレーザー光は、コリメータ１０２の凸レンズ作用により平行なビームとなり、プリズム１１１に続いて光路合成分離プリズム１０６を透過し、ミラー１０９で反射され、対物レンズ１０７によって光ディスク２の記録層２２内の所定の深さ位置に集光される。記録層２２内で反射された光は、逆の経路を辿り、プリズム１１１で反射され、再生信号検出光学系１１２へ導かれる。

【００２４】一方、サーボ用レーザー１０３から射出されたレーザー光は、コリメータ１０４の凸レンズ作用によりほぼ平行なビームとなり、プリズム１１３を透過し、光路合成分離プリズム１０６で反射され、ミラー１０９で反射され、対物レンズ１０７によって光ディスク２の反射層２１に集光される。反射層２１で反射された光は、逆の経路を辿り、プリズム１１３で反射され、サーボ信号検出用の光学系１１４へ導かれる。

【００２５】望ましくは、記録再生用レーザー１０１とサーボ用レーザー１０３は異なる波長の光を発し、光路合成分離プリズム１０６は波長依存性により光路を合成分離する。このような光路合成分離プリズム１０６には、例えば、特開平４－２９１０３９号に開示されているダイクロイックミラーが適用される。

【００２６】一般には、波長が短いレーザー光ほど微小なスポットに絞り込めるので、好ましくは、記録再生用レーザー１０１には、サーボ用レーザー１０３と比較して、短い波長の光を発するレーザーが用いられる。例えば、記録再生用レーザー１０１には６８０ｎｍ帯のレーザーが使用され、サーボ用レーザー１０３には７８０ｎｍ帯のレーザーが使用される。

【００２７】ダイクロイックミラーを用いることにより、二つのレーザー光を波長に基づいて正確に分離できるので、この光ピックアップ装置は互いの干渉の無い安定した記録再生を行なえる。

【００２８】サーボ信号検出光学系１１４は、サーボ用レーザー１０３から射出され反射層２１に集光されたサーボ用レーザー光の合焦状態に応じたフォーカスエラー信号とトラッキングエラー信号を検出する。サーボ制御回路４は、これらの信号に基づいて、サーボ用レーザー光が反射層２１に焦点を結ぶように、対物レンズ１０８の光軸に沿った位置を制御する。

【００２９】また、再生信号検出光学系１１２は、記録層２２に記録された情報の検出を行なう。記録再生制御回路３は、再生信号検出光学系１１２の出力に基づいてデータの再生を行ない、その結果を図示しないホストへ転送するとともに、ホストから送られて来るデータに従って記録再生用レーザー１０１を制御し、記録層２２への記録を行なう。データの記録は、記録再生用レーザー１０１の出力パワーを高めて、記録層２２に物理的な変化、例えば屈折率の変化等を発生させることで行なわれる。

【００３０】記録層２２の内部における記録再生用レーザーの集光点は、次のようにして、その層方向の位置すなわち光軸に沿った位置を変えられる。以下の説明では、初期状態において、サーボ用レーザー光は反射層２１に焦点を結び、記録再生用レーザー光は記録層２２の中央付近に焦点を結んでいるものとする。

【００３１】サーボ用レーザー光が反射層２１に合焦している状態で、図２(ａ)に示されるコリメータ駆動信号に従ってアクチュエータ１０５を駆動すると、図２(ｂ)に示されるようにサーボ用レーザー１０３の射出光を略平行光化するコリメータ１０４の位置が変化し、コリメータ１０４から対物レンズ１０７に至る光束の平行度が変化する。

【００３２】その結果、反射面２１に対する合焦状態が変化するが、この変化は、サーボ信号検出光学系１１４によって、図２(ｃ)に示されるフォーカスエラー信号の値の変化として検出される。サーボ制御回路４は、図２(ｄ)に示されるように、フォーカスエラーを打ち消す対物レンズ駆動信号に従ってアクチュエータ１０８を駆動し、対物レンズ１０７の光軸に沿った位置は図２(ｅ)に示されるように変化する。その結果、サーボ用レーザー光の集光点は再び反射層２１へと移動されてフォーカスエラー信号の値はゼロへ戻る。

【００３３】一方、記録再生用のレーザー光は、その平行度が一切変化していないので、対物レンズ１０７が光軸に沿って移動した分だけ、記録再生用レーザー光の集光点は記録層２２の内部を光軸に沿って移動する。

【００３４】つまり、サーボ信号用レーザーのコリメータ１０４の位置を変えることにより、記録層２２の内部における記録再生用レーザー光の集光点の層方向の位置が変えられる。

【００３５】記録再生用レーザー光の平行度は変化しないため、対物レンズ１０７に入射する記録再生用ビーム光のビーム径も変化しない。従って、対物レンズ部分におけるカップリング効率つまり光の利用効率が変化することはない。その結果、対物レンズ１０７から記録層２２へ到達する光量が安定するため、この光ピックアップ装置は安定した記録再生を行なえる。

【００３６】なお、サーボ用レーザー光については、その平行度が変化するために、対物レンズ部分におけるカップリング効率が変化し、パワー変動が発生するが、一般にサーボ制御回路４の中ではエラー信号をその和信号(総光量)で規格化するＡＧＣ(Auto Gain Control)の動作を行なっているため、検出されるエラー信号へのパワー変動の影響は吸収され、特に問題にはならない。

【００３７】［第二の実施の形態］第一の実施の形態は、記録再生用レーザー１０１の射出光をコリメータ１０２で平行化してそのまま対物レンズ１０７へ導いているが、一般に半導体レーザーの射出光の光量分布は楕円状であるため、このままでは長軸方向の光量を蹴って使うことになり、パワー効率が悪い。

【００３８】第二の実施の形態の光学式情報記録再生装置は、このような第一の実施の形態のパワー効率の悪さを改善したものであり、図３に示されるように、コリメータ１０２とプリズム１１１の間に配置されたビーム整形プリズム１２０を更に備えている。この光ピックアップ装置は、ビーム整形プリズム１２０が追加されている以外は、第一の実施の形態と全く同じである。

【００３９】ビーム整形プリズム１２０は、非平行な入射面と射出面を持ち、紙面と垂直な方向については倍率を持たないが、紙面と平行な方向については倍率を持ち(アナモフィックな特性を持ち)、透過するビームの一方向(図３では紙面と平行な方向)のみを拡大し、ビーム断面の光量分布を真円に近づける。その結果、ビーム断面は略真円となり、対物レンズ１０７を始めとする光学部品による蹴られがなくなり、ビームの利用効率が高められる。

【００４０】ビーム整形プリズム１２０に入射するレーザー光には高い平行度が要求される。なぜなら、平行度の低いビームは、ビーム整形プリズム１２０のアナモフィックな特性のために、これを通過した後に非点収差を持ってしまう。非点収差は、記録層２２の内部に形成されるスポット形状を崩し、安定した記録再生を妨げる。

【００４１】この実施の形態では、記録再生用レーザー光の集光点の移動は、記録再生に用いないサーボ用レーザー１０３のためのコリメータ１０４が移動されることにより行なわれる。記録再生用レーザー光の集光点の移動のために、記録再生用レーザー１０１のためのコリメータ１０２が移動されることはないので、ビーム整形プリズム１２０に入射する記録再生用レーザー光の平行度を精度良く管理することができる。従って、記録再生用レーザー光に非点収差が発生することはない。

【００４２】この実施の形態によれば、ビーム整形を行なうことにより記録再生用レーザー光に高い利用効率を確保しながらも、記録再生用レーザー光に収差が発生しないため、高パワーが要求されるディスク回転数の高い光ディスクドライブへの適用においても、安定した記録再生を行なえる。

【００４３】［第三の実施の形態］第一の実施の形態では、記録再生用レーザー光の集光点の移動は、最初にサーボ用レーザー光を略平行化するコリメータ１０４を移動させ、この移動により生じたサーボ用レーザー光の焦点ずれを補正するように対物レンズ１０７を移動させることで行なわれる。その際、コリメータ１０４の移動により生じる焦点ずれを検出し、これに応じて対物レンズ１０７を移動させ、サーボ用レーザー光の集光点を反射層２１の位置に戻すフィードバック制御が行なわれる。

【００４４】記録再生用レーザー光の集光点はフィードバック制御によって記録層２２の内部を移動されるため、記録再生用レーザー光の集光点が記録層２２内の目標位置に配置されるまでには時間がかかる。具体的には、記録再生用レーザー光の集光点の移動時間は、概ね、コリメータ１０４の応答時間とフォーカス制御系の応答時間の和となる。

【００４５】第三の実施の形態による光学式情報記録再生装置は、このような第一の実施の形態のアクセス時間の改善を図ったものである。図１に示されるサーボ制御回路に代えて適用される制御装置を図４に示す。

【００４６】図４に示されるように、この制御装置４０は、フォーカスエラー信号を入力とし、フォーカス制御のループを安定化するための位相補償回路３０１と、記録再生用レーザー光が集光される位置を設定する記録再生層設定回路３０２と、コリメータ駆動電流設定回路３０３と、ゲイン補正回路３０４と、加算回路３０５とを備えている。コリメータ駆動電流設定回路３０３の出力はコリメータ１０４を駆動するアクチュエータ１０５に入力され、加算回路３０５の出力は対物レンズ１０７を駆動するアクチュエータ１０８に入力される。コリメータ駆動信号をゲイン補正回路３０４を介して対物レンズ駆動信号に加算することにより、フィードフォワード制御の経路が構成されている。

【００４７】記録再生層設定回路３０２は、記録再生用レーザー光の層方向位置すなわち深さ位置を決定し、コリメータ駆動電流設定回路３０３は、これに相当する駆動電流を設定する。アクチュエータ１０５は、図５(ａ)に示されるコリメータ駆動信号に従って駆動され、コリメータ１０４の位置は図５(ｂ)に示されるように変化する。

【００４８】これと同時に、アクチュエータ１０５を駆動するコリメータ駆動電流は、ゲイン補正回路３０４にも入力され、ゲインの補正が行なわれた後、加算回路３０５により位相補償回路３０１の出力に加算される。従って、アクチュエータ１０８には、図５(ｄ)に示される対物レンズ駆動信号が供給され、これに応じて、対物レンズ１０７の位置は図５(ｅ)に示されるように変化する。

【００４９】ゲイン補正回路３０４は、コリメータ１０４の移動により生じる反射層２１からの焦点ずれを、対

物レンズ１０７の移動によりちょうど打ち消す信号を出力する。すなわち、ゲイン補正回路３０４のゲインは、コリメータ１０４と対物レンズ１０７の倍率、アクチュエータ１０５とアクチュエータ１０８の駆動感度により決定される。

【００５０】このように、コリメータ１０４の移動に合わせて、対物レンズ１０７にフィードフォワード制御を行なうため、フィードバック制御のみによる制御と比較して、図５(c)から分かるように、サーボ用レーザー光の集光点の位置変動がほとんどなくなる。つまり、記録再生用レーザー光の集光点移動時間にフォーカス制御系の応答時間が影響しなくなる。従って、移動時間は、コリメータ１０４を駆動するアクチュエータ１０５と、対物レンズ１０７を駆動するアクチュエータ１０８の応答時間によって決まる。その結果、本実施形態による光学式情報記録再生装置は、記録再生用レーザー光の集光点の深さの変更、すなわち記録面の切り替えを高速で行なえる。

【００５１】これまで、いくつかの実施の形態について図面を参照しながら具体的に説明したが、本発明は、上述した実施の形態に限定されるものではなく、その要旨を逸脱しない範囲で行なわれるすべての実施を含む。

【００５２】例えば、上述した実施の形態では、記録再生用ビームがひとつの構成を述べたが、複数の記録再生用ビームにより並行して記録再生を行なう構成にも適用できる。

【００５３】また、波長依存性によりビームを分離する構成を述べたが、例えば偏光によりビームを分離する構成としてもよい。

【００５４】本明細書は以下の発明を含んでいる。

（１）サーボ制御の基準を与える反射層と異なる深さに独立に情報が記録され得る記録層とを有する光記録媒体に対して情報の記録再生を行なうための光ピックアップ装置であり、サーボ制御のための第一のビームを発する第一の光源と、記録再生のための第二のビームを発する第二の光源と、第一のビームを略平行化する第一のレンズ手段と、第二のビームを平行化する第二のレンズ手段と、第一のレンズ手段を第一のビームの光軸に沿って移動可能に支持する第一のレンズ駆動手段と、第一のビームと第二のビームをそれぞれ光記録媒体の反射層上と記録層中に集光するための対物レンズと、対物レンズを光軸に沿って移動可能に指示する対物レンズ駆動手段と、異なる方向から来る第一のビームと第二のビームを共に対物レンズに向かわせるとともに、対物レンズを通ってくるそれぞれのビームの光記録媒体からの反射光をそれぞれ来た方向に向かわせるビーム合成分離手段とを備えている光ピックアップ装置。

【００５５】（２）第二のレンズ手段とビーム合成分離手段との間に配置された、第二のビーム断面の光量分布を円形に近づけるよう整形するためのプリズムを更に備えている、（１）に記載の光ピックアップ装置。

【００５６】（３）サーボ制御の基準を与える反射層と異なる深さに独立に情報が記録され得る記録層とを有する光記録媒体に対して情報の記録再生を行なう光学式情報記録再生装置であり、サーボ制御のための第一のビームを発する第一の光源と、記録再生のための第二のビームを発する第二の光源と、第一のビームを略平行化する第一のレンズ手段と、第二のビームを平行化する第二のレンズ手段と、第一のレンズ手段を第一のビームの光軸に沿って移動可能に支持する第一のレンズ駆動手段と、第一のビームと第二のビームをそれぞれ光記録媒体の反射層上と記録層中に集光するための対物レンズと、対物レンズを光軸に沿って移動可能に支持する対物レンズ駆動手段と、異なる方向から来る第一のビームと第二のビームを共に対物レンズに向かわせるとともに、対物レンズを通ってくるそれぞれのビームの光記録媒体からの反射光をそれぞれ来た方向に向かわせるビーム合成分離手段と、第一のレンズ駆動手段の駆動信号を対物レンズ駆動手段の駆動信号に加算する加算手段を含み、第一のレンズ駆動手段の駆動信号を対物レンズ駆動手段へフィードフォワードする制御手段とを備えている光学式情報記録再生装置。

【００５７】（４）前記第一のビームと前記第二のビームはその波長が互いに異なり、前記ビーム合成分離手段は、波長依存性によりビームの分離を行なうことを特徴とする（１）に記載の光ピックアップ装置。

【００５８】（作用効果）波長依存性によりビームの分離を行なえば、ビームの分離を低損失で行なうことができ、信号品質が向上し、高密度での記録再生も可能になる。

【００５９】（５）第二のビームが第一のビームよりも短波長であることを特徴とする（４）に記載の光ピックアップ装置。

【００６０】（作用効果）波長の短いレーザー光ほど微小なスポットに絞り込めるので、記録再生用の第二のビームの方を短波長とすれば、高密度な記録再生が可能となる。

【００６１】（６）少なくとも対物レンズを含む移動光学系と、少なくとも第一の光源及び第二の光源を含む固定光学系とから成る分離光学系であることを特徴とする（１）に記載の光ピックアップ装置。

【００６２】（作用効果）分離光学系の採用によりピックアップの可動部分を軽量化することができ、高速移動が可能となるため、高速アクセスを実現することができる。

【００６３】

【発明の効果】本発明によれば、記録再生用ビームの平行度が変動せず安定した記録再生を行なえる光ピックアップ装置が提供される。また、安定した記録再生を行なえるので、分離光学系に適用して高速アクセスを実現し

た光ピックアップ装置を提供することもできる。

【図面の簡単な説明】

【図１】本発明の第一の実施の形態による光学式情報記録再生装置を示している。

【図２】図１の光学式情報記録再生装置における、記録再生用レーザーの集光点の層方向の位置の変更を説明するためのタイムチャートである。

【図３】本発明の第二の実施の形態による光学式情報記録再生装置を示している。

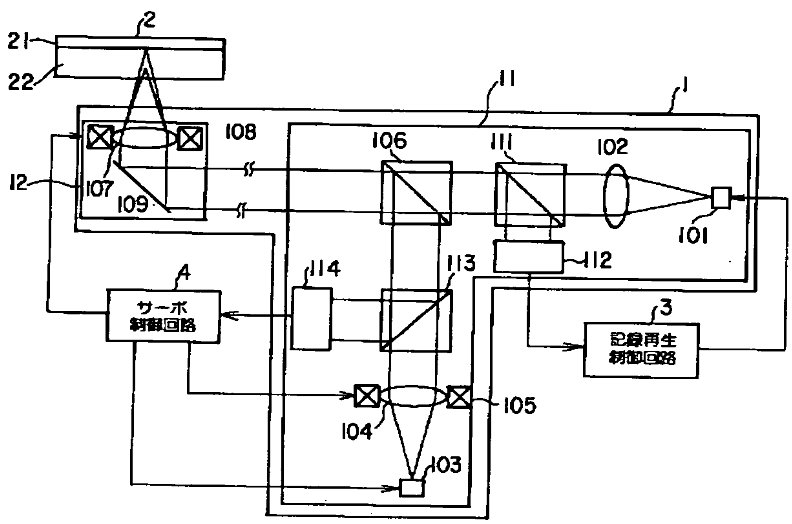
【図４】本発明の第三の実施の形態に関する、図１のサーボ制御回路に代えて適用される制御装置を示している。

【図５】図４の制御装置による、記録再生用レーザーの集光点の層方向の位置の変更を説明するためのタイムチャートである。

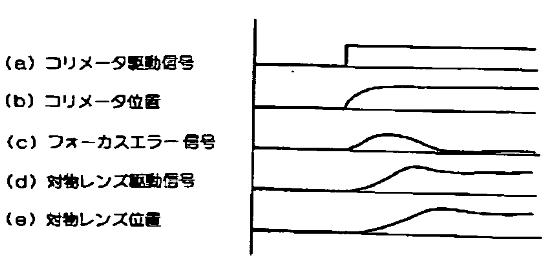
【符号の説明】

1　光ピックアップ装置
１１　固定光学系
１２　移動光学系
１０１　記録再生用レーザー
１０２　コリメータ
１０３　サーボ用レーザー
１０４　コリメータ
１０５　アクチュエータ
１０６　光路合成分離プリズム
１０７　対物レンズ
１０８　アクチュエータ

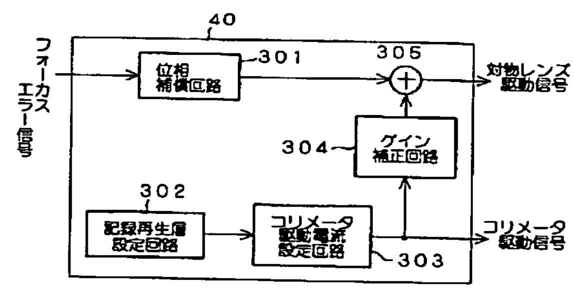
【図１】



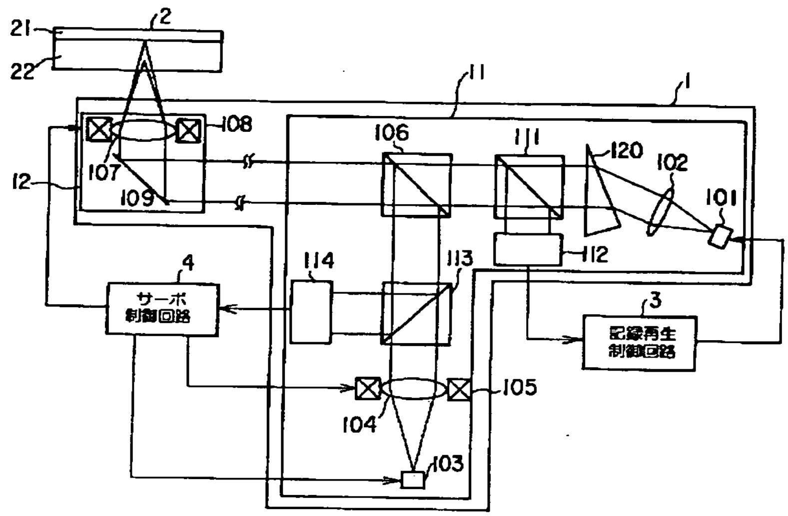
【図２】



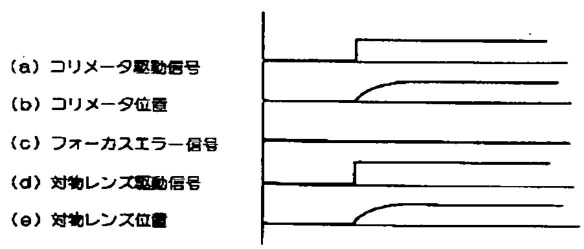
【図４】



【図３】


21
2
22
11
1
108
106
111
120
102
107
109
101
12
112
4
114
113
サーボ
制御回路
3
記録再生
制御回路
105
104
103

【図５】


(a) コリメータ駆動信号
(b) コリメータ位置
(c) フォーカスエラー信号
(d) 対物レンズ駆動信号
(e) 対物レンズ位置